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O B S E R V A T I O N S

BY

ROBERT WHITWORTH, Esq; Engineer,

ON

SEVERAL SCHEMES and PLANS propofed for Enlarging and  
Improving the *HARBOUR of LEITH*,

WITH

ANSWERS to the OBJECTIONS made to TWO PLANS formerly  
prefented by him,

IN

A LETTER to the Right Honourable the LORD PROVOST of  
EDINBURGH.

EDIN<sup>r</sup>. 8th JANUARY 1787.

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TO THE RIGHT HONOURABLE

THE LORD PROVOST  
OF EDINBURGH.

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MY LORD,

I HAVE seen the various schemes proposed for the Improvement of the Harbour of Leith, in opposition to the two Plans I proposed, and have considered the objections stated in the papers your Lordship put into my hand.

AND, *first*, I will endeavour to answer those made by a Member of the Chamber of Commerce, in a letter to your Lordship and Magistrates, dated Edinburgh, 21st December 1786; the author of which, I understand, is a very worthy, well-meaning gentleman, and more extensively concerned in shipping than any other merchant about Leith: But as he has advanced arguments that are not well-founded, in favour of making the improvement of the Harbour in the River, in opposition to the proposition of making a Basin above Leith Mills, or Wet-Dock on North-Leith Sands, I trust, I can convince your Lordship, and this gentleman, of the fallacy of his propositions.

AND

AND as this letter has been printed, and circulated round the country, I shall be the more particular in my remarks upon it.

THIS gentleman has many objections to the Basin above the Mills; some of which are very ill-founded indeed: He roundly asserts, 'That vessels would require at least two days to work up into the Basin, and would injure themselves *greatly* in passing through the Lock: that it would only take in small vessels, or light ships of ten feet water; and that they would be froze up in the Winter.'

THIS gentleman seems to be ignorant, that the scheme he proposes is liable to every one of these objections in a greater degree, together with the addition of some others, far more serious.

IN answer to the *first* objection, in which it is asserted, 'That it will require two days to work a vessel up to the Lock,' I will likewise assert, that, after a vessel is brought up as far as the tide will bring her, suppose to the Bridge, or even no higher than the New Quay, it is very easy, in *less than half an hour*, to convey her to the tail of the Lock at the Mills; and *ten or twelve minutes more* will set her fairly into the Basin, where she may proceed to her birth at leisure: And this may be done, even *after high water*, or in time of *spouts*, at a very few shillings expence.

THIS business may be performed in the following manner: Supposing a towing or hauling-path to be made from the Bridge to the tail of the Lock, which may easily be made, without disturbing the house at the corner of the Bridge, or much injuring any one:—this being done, the end of a line may be sent down in a small boat, from the Bridge to a ship at the New Quay, or below, and having two or three horses, which will be sufficient if the tide be flowing,  
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(for these animals are far better calculated for drawing heavy burdens with expedition than *sailors*, with their blocks and tackle); but if it be after high-water, or when there is any great quantity of land-water coming down, more horses may be necessary, which there never can be any difficulty in procuring, as there is always a great number of carters upon the spot, who would be glad to earn *sixpence* with their horse, which they would so easily do, in less than half an hour. Thus, a ship being taken up in this very easy manner, may be guided so as not to disturb, or even *touch*, any of the ships lying at the Quay, or on the opposite side of the River, if there be her own width left for a passage.

BUT if the Quay that the gentleman proposes to make from the Bridge to the Mills *was made*, and ships lying against it, there could be no other way of getting vessels up from the Dam he proposes at Barnard-Street, to the upper end of the Quay at the Mills, than warping them, or hauling them with small boats; which would really be a tedious operation, and sometimes scarcely practicable.

As to the objection of a ship's passing through a Lock, which, the gentleman says, '*every one knows*, must hurt her very much'—

I AM sorry that he doth not know, that he must likewise have a Lock in the Dam he proposes at Barnard-Street; otherwise, it may sometimes be a week together, or more, that ships cannot pass.—In short, at all times, when there is any great quantity of land-water coming down, they cannot pass at all *without one*: and this Lock would stand in rather a perilous situation; for when a ship comes into the Harbour in stormy weather, when the wind is from the north, it perhaps may be difficult to break her way before she comes up to the Lock; and the water being much agitated, *every one knows*, that a ship entering a Lock, under such circumstances, may *hurt her*

*very*

*very much*; though the greater danger would be, damaging the gates of the Lock. But it cannot be so in a Lock placed above the Mills, for there the water would always be smooth; and if a ship was made of glass, or any other brittle materials, she might be conducted through the Lock into the Basin with the greatest safety; for she need not touch either the sides or gate of the Lock at all.

ANOTHER objection is, that the Basin will only *take in small vessels, and light ships, at ten feet water.*

THIS objection will likewise operate against the River scheme.— In my Report, I pointed out a very easy way of making the Basin 12 feet, or even 14 or 15 feet deep, if found eligible so to do; and as the enlargement he proposes, is upon the *very ground* through which I *only* propose to make a *narrow channel* for the ships to pass through, I trust he will allow it to be easier for me to make a channel, and keep it open, in the manner I proposed in my Report, to the depth there mentioned, and represented upon the Profile, (or to any other depth that may be thought proper), than for him to deepen the whole width of the River, together with the additional width he proposes to take from the sides; so there can be but small chance of taking so large ships into the part above the Bridge, as could be taken into the Basin.

THE objection of being froze up in Winter, will be common to them both: Yet even this will preponderate in favour of the Basin; for by the flux and reflux of the tide, the ice in the River will always be *kept broke*; so that a vessel in the Basin will only have to *break her way to the head of the Lock*: But when the Dam is made at Barnard-Street, the flow of the tide will be stopped; consequently, all the ships in the Harbour above that Dam will be froze up, (it being all *fresh water* as well as the Basin), so that it would be a tedious



dious piece of work to *break a passage for a ship* lying above the Bridge. So that every one of the objections this gentleman makes against the *poor Basin*, operates against his own scheme with double force.—In addition to the observations I have made, I must now bring the floods, which is more serious than all the rest: These floods sometimes rise to an amazing height, and are dreadfully rapid: A notable instance of this happened a few days ago. Had the proposed Dam been built, the flood, which appears to be almost lost, in passing through the great body of water in the Harbour when the tide is up, would have shown itself in such a manner, that it is more than probable many persons in Leith would have had sad cause to remember the day; and the flakes of ice would have come over the Dam at the Mills with such a velocity, as would have made dreadful devastation among the vessels that lay near that place.

WITH respect to the proposed Wet Dock by the Citadel, this gentleman says, 'It is the best of the two *plans*, but, like the other, 'is attended also with *going through a Lock*; besides, after costing '19,787 l. Sterling, it will only be fit to take in small ships, or 'light ones, having no more than 12 feet water at spring-tides.'

As these are all the objections that the gentleman makes to this *plan*, I shall have no difficulty in obviating and clearing them up to the satisfaction of your Lordship, and, I trust, even to this gentleman, and every one else, who have not previously resolved that nothing shall convince them: Of this description, I know, or at least, am informed, there are many, relative to the improvement of Leith Harbour.

As this gentleman, and many others that I have conversed with, seem to be so much alarmed at the idea of a ship passing through a lock, they not having seen any such thing, I will here explain to

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your Lordship, and these gentlemen, that they are the most innocent things in the world, and will hurt nothing: It is impossible that ships can receive the least injury in passing through them, in either of the situations I have proposed; and, in any situation, are less hazardous than single pairs of gates; and infinitely more advisable in this instance, and must be in every other where the Dock is so very large:—If it be made complete with two pairs of gates (which is the case with *Greenland Dock* on the side of the river Thames), vessels may enter at all times, when there is depth of water for them to *swim* to the tail of the Lock, notwithstanding the internal water may be five or six feet higher than the external, with the greatest ease and safety: But if there was only a single pair of gates, the water within and without must be brought to a level, before the gates will open, or any thing pass, which would require much time and trouble to regulate, in so large a surface of water; in a small surface, it is not so very material: The way to regulate it, when the *spring-tides* are *falling off*, would be, to draw the sluices of the gates, to reduce the water within to the height the next tide may be expected to rise, which no man can with certainty know, therefore may let out too much, or too little; in either case, it would cause some delay, and, before the neap-tides come to be lowest, all the large ships will be laid upon ground; but, as they are now upon ground every tide, perhaps that may be thought no inconvenience: The greater detriment that single gates would occasion, would be, in the advance of the tide from neap to spring-tides, in which it may sometimes happen that a tide may be some feet higher than the previous tide; in that case, the water would pass through the gates with great velocity, till the external and internal water are brought to the same level; to do which there may not always be time to effect, before the tide returns; in which case, there will not be one moment's time of *still* water for ships to come out of the Basin; and ships entering, when the water runs in with such rapidity, may damage themselves,



or the gates. Another bad consequence that would attend a single pair of gates, is,—All the water that enters the Dock in the advance of the spring-tide, to supply the place of that let out upon its decline, will always come loaded with small sand, mud, or silt, every atom of which it will drop in the Dock; so that once in every fortnight, there will be a certainty of depositing as much mud and silt as float in six or seven feet depth of water, which will raise the bottom, though insensibly, yet it will rise, and in time will want cleansing out: But if a Lock, or double pair of gates be made use of, there can be no visible cause to diminish the depth, except the water be sometimes drawn out, to assist the land-floods in scouring the bar; but I would not draw the water out of the Basin, at any other time but when there is a land-flood coming down, for, of itself, it most certainly would do little good: Another reason is, the Lock proposed by me is necessarily placed in such a direction, that the water issuing from it will require a body of land-water to give it a proper direction, to prevent its striking the Quay-wall on the opposite side.

BUT previous to these scours being let off, it would be found of advantage, if a large *Hedgehog* or *Spiked Roller*, about *ten feet long*, were sometimes drawn down the Harbour, and over the Bar, a little before low water; and when the tide turns, it might be brought back in the same manner: This may be done, by fixing the Roller to the stern of a vessel, drawn by a *water sail*, which would draw it along with great power, and be easily managed with a little practice: In this manner the Bar might be scoured down as low as can be desired. By this means the river Stour, which runs through Sandwich Harbour, was scoured down many feet lower than it was ever known to be before; and the new cut at Grangemouth was wrought down, by such a machine, to as great a depth as is or can be wanted.

As:

As to the other objection, That ' it will only be fit to take in ' small ships and light ones, having no more than 12 feet water at ' spring-tides.'

IN answer to this, I will just observe, that had I known that my Report would have been printed, much less published, I would have been more particular in explaining many things about this Dock, which, I am convinced, merits great attention, much more than I have given it: For, when I came to Edinburgh to attend the meeting of the Company of Proprietors of the Forth and Clyde Canal, in November last, I brought my Report and Plan with me, both far from being finished in the manner I meant to have done them, and of course intended to have taken them back; but business intervening just then, I could not be allowed time to give them any farther consideration; therefore, left them in the unfinished state your Lordship now sees them.

It is true, in my *Estimate*, I mention clearing away the sand to the depth of *twelve feet* below the high water of an ordinary spring-tide; from which this gentleman concludes, that a vessel drawing more than 12 feet water cannot enter: But I always proposed and meant, to lay the fills of the Lock as low as the level of the Harbour opposite, or even as low as the *Bar*, if it was found expedient so to do; and as some part of the ground proposed to be inclosed in this Dock is already *ten feet* below the high water of a spring-tide, therefore every one must allow, that it will be no great work to dig so much of it, to the depth of the Lock-fills, as will be sufficient to give *births* to as many of the large ships as may be found necessary, and what I always meant to be done: It can never be necessary to dig it all to that depth; so that the mean depth of *twelve feet* may be as deep as may be found proper to dig.



So that it must be allowed by every one who is acquainted with this kind of business, that there is not, nor can be a shadow of a doubt, but that this Dock may be made to receive the *largest ships that can come over the Bar.*

Thus, I trust, I have answered, or obviated, all the objections stated by the Gentleman of the Chamber of Commerce.

THERE are some other objections contained in a very long anonymous letter, addressed to your Lordship, dated Leith, 19th December 1786. In this letter, there are *five objections* to the Basin above the Mills, stating the difficulty of conveying a ship through the Harbour, &c. (which I have already answered);—the choaking the Harbour up with mud, by making its bottom more upon a level, &c.; all which are conceived in such inconsistent loose terms, that they do not deserve any answer. You will judge what credit ought to be given to a man of this stamp, by the following assertion: In his 4th objection he says, ‘the *building* (meaning the masonry) and *price of the land, is not one third of the value.*’ In answer to which, I do assure your Lordship, that if this work was to be done in the neighbourhood of Glasgow, or where the works of the Great Canal are now carrying on, it would be done 10 *per cent.*, and some of it 12 *per cent.* less than the prices I have set down in the Estimate; and I did never conceive there could be a greater difference in the price of masonry between those two places. In this letter there are also ten observations on the proposed Dock on North-Leith Sands; the three first of which are favourable, extolling the situation, &c. In the 4th and two following, he attacks the construction of the Pier in these words: ‘The plan is fallacious: That the outward barrier is only founded *six feet* below low-water mark, when the internal Basin is 12 feet deep: That a barrier of six feet is not solid enough: That a barrier to defend the sea, should be 10 feet

'thick:' and a great deal more such incoherent stuff. I cannot conceive how these things came into the man's head, for he could find no such thing in my Report, or Section and Plan of the proposed Pier. But as several gentlemen may have seen this letter, and as the word *fallacious* is mentioned, I will here shortly explain the Plan and Section of that Pier, as I did not do it in my Report, for reasons before given; and the engraved sketch of the Plan being so wretchedly executed, that it is scarcely intelligible.

THE ground upon which this Pier is proposed to be built, I am now convinced, is as good a foundation as can be in the world for such a building: The form to be circular, containing about 75 degrees of the arch of a circle whose radius is 1000 feet; which form suits the ground well, and gives it great strength to resist the violence of the sea: This Pier is to consist of two parallel walls, the outer one, or barrier against the sea, to stand upon a base of 14 feet, the parapet of which to be raised about 18 feet above a spring-tide: This, I believe, or at least am informed, will be a sufficient height to screen the ships that ly in the Dock, from the north and west winds: The back side of this wall to *batter* or *fall inwards*, in the proportion of 1 to 3, as represented upon the section: The inner-wall to stand upon a six feet base: The two walls to be tied together by cross-walls, at the distance of about 30 feet, or oftener, if thought necessary: The space between these walls, which is to be 15 feet at the least, (or, if it was to be 20 feet, it would not be the worse, only a little more expensive, as the *tie-walls* would require to be five feet longer), to be filled with earth and clay, and worked as described in the estimate, to make the Pier water-tight.

HERE I will mention another matter, that I omitted in my Report of the 7th November last, which appears to be necessary, to prevent the swell of the sea into the mouth of the Harbour, which  
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this Pier might have a tendency to increase; this is, to run out a Pier-head of whin-stones (*only*) from the end of the North Pier: The direction should be nearly north, and the length about 100 feet: The Harbour would be the better for it in its present state, supposing this Pier not to be built.

THE foundation of this Pier I propose to be laid to low water-mark at the least, or to the level of the bar, if it can be done, which is lower, by many feet, than the foundation of the present Pier; and, if a proper method be pursued, there will not be much difficulty in doing it to that depth, as there is but little depth of sand before it come to very strong clay and till; so that there can be no fear of this Pier failing for many ages to come, if done with proper materials.

THE real and principal objection that I conceive some of the gentlemen of Leith have to the two plans I have proposed, have not yet appeared either in writing or print that I have seen, and is this, —The proposed new Quays being at so great a distance from the present warehouses, which have been erected at so great an expence.— There is some reason in this objection, and what most gentlemen in their situation would make; but it never can be imagined, that the *births* for ships along the present Quay will not be occupied, whatever plan be adopted; consequently, those warehouses will not be deserted; though, if the Basin above the Mills was to be adopted, it is most certain, that a great number of new ones would be erected, as they would be so much more convenient for the Edinburgh goods. Indeed, let the improvement of the Harbour be made wherever it may, new warehouses will be built: it will be in vain to attempt to confine the trade to the present ones in Leith, although most of the plans and schemes suggested by these gentlemen seem to have that for their object, and that only: I do not think  
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public utility has been much consulted: But, if the Wet Dock at North Leith was to be adopted, this objection might, in a great measure, be done away, by making a commodious Draw-bridge (wide enough for two carts to pass each other) opposite the end of Barnard-Street: This Bridge would place the proposed Quay at North Leith, almost as near to those warehouses, as the present Quay from the Bridge downwards.

HAVING answered, or, in some degree, obviated all or most of the objections made to my plans, I come now to the most disagreeable part of the task which your Lordship and Council have been pleased to lay upon me, that is, to give my opinion upon the plans and schemes that have been given in by others.

I SHOULD have been glad this part of the business had been laid upon another, as I may be suspected of partiality to my own schemes: But, since You have been pleased to honour me with your confidence, I will give you my opinion of the various plans and schemes submitted to me, in the same impartial manner as if I was not in the least concerned, and hope the reasons I shall give, will induce your Lordship and Council to think so.

ONE of these plans for making the improvement of the Harbour in the bed of the river, proposed by a member of the Chamber of Commerce, I have already considered in the answers to the objections that gentleman made to my plans; and the reasons I have given, I trust, will induce your Lordship to think, with me, that it ought not to be adopted.

I WILL next make a few remarks upon the plan presented by Mr Cuth. Clarke.

THIS



THIS plan, like the former, takes in the present Harbour, in addition to which, it is proposed to take in a considerable part of North Leith, including the two Dry Docks, also a part of Sheriffbræ: the whole to be made into a Wet Dock.

THIS is an exceeding neat plan, and the design masterly, with an ingenious dissertation upon the tides, and description of the plan; but as he has not given a particular estimate of the several parts of the work, therefore cannot say what *prices he has allowed*; though, from the surveys and levels I have taken of almost every part, I could make a calculation of the quantity of masonry that it would require to complete the several works described, and could come pretty near the quantity of digging; but this I dare say Mr Clarke has done with great accuracy, and allowed proper prices for the work.

THIS plan contains two different designs, the lesser of which he estimates at 12,410 l.; and that upon the larger scale at 15,640 l., exclusive of the purchase of houses, docks, lands, &c. But the expence is the least part of the consideration, therefore will pass it by altogether, without further notice.

THERE are many serious objections to the carrying of this plan into execution, some of which are of such a magnitude, that I am astonished a gentleman of Mr Clarke's great ability, scientific knowledge, and discernment, should have overlooked them.

THIS gentleman has proposed to divert the course of the river through the ditch made by Oliver Cromwell round the west side of the Citadel, by making a Dam across the river a little above North Leith Church-yard: This would be no easy matter to accomplish; and, if Mr Clarke has not had experience in making dams, and di-

verting rivers under such circumstances, I will venture to say, he will find it a more difficult task than he is aware of; yet, no doubt, it may be done. Mr Clarke also proposes to make a Dam and Lock opposite Barnard-Street, if his plan upon the *lesser scale* be adopted; or, if his *larger plan* be preferred, then to place the Dam and Lock about 100 yards lower down, nearly opposite the point of the Ballast Quay. By this means, both the *land-floods* and the *tides* will be prevented from flowing through the Harbour.

If either of these plans were to be carried into execution in the manner described above, there is not, nor can be the least shadow of doubt, but *certain and inevitable ruin would soon ensue*. For it is manifest, that the constant flux and reflux of the tide flowing over the Bar and through the Harbour, which is about 1300 yards long, and, at the time of spring-tides, of a considerable *depth* and *width*, consequently will contain a vast body of water, a great part of which passes *over the Bar four times a day*, sometimes with rather a quick motion, *both ways*, together with the assistance of all the land water, has been found little enough to keep the *Bar down*; nay, if it was not for the prodigious land-floods that frequently happen in the Winter, it is most certain it would not be scoured to the depth it is; for in Summer, and in any long dry season, it is always known to rise, which is the case with *all bars* under the same circumstances. But, taking the tide away, (which, by the stoppage at the Lock, its effect will be totally lost), and taking the great floods away! what must the consequence be? The answer is plain! *Most certainly the ruin and very existence of the port*: And to effect this with the greater rapidity, the very land-floods, which sweep the Harbour from *side to side*, and clear it of mud, which *hitherto has been the salvation of the port*, are now to be taken off from their ancient, natural, and *friendly* course, in such a manner as will make them act the part of the most *unnatural enemies*! It must be so! it cannot



cannot be otherwise: For, by diverting the River round the Citadel, and cutting a channel for it only three feet below the top of an ordinary spring-tide, (which is the depth Mr Clarke proposes), there will be a fall of 12 or 13 feet to low water; and as water, by its own gravity, finds the shortest course to the lowest part; this will be the channel through which the ships now pass; somewhere near the Bar, a little above or below, as the wind shall happen to be: Now, my Lord, figure to yourself the idea of a *great land flood*, such as happened only a few days ago, coming pouring down from the east corner of the Citadel, *at low water*; this would most undoubtedly make down to the ships channel, as being the lowest place, cut across it, and fill it up level with the adjacent sands, and, of course, the channel would be ruined; as there can be no power of water from the Harbour to counteract this large body, that comes across in such a mischievous manner.—So much for the Bar.

Now, for a moment, I will suppose the Bar not injured by this diversion, and will enquire what the effects may be in the Harbour itself.

ADMITTING the Dam and Lock, and also the Dry Docks, to be built as represented upon the plan, (on the larger scale), this would stop the tide from flowing further; there would scarce be any motion within the points of the Piers; therefore the water would *rise* and *fall* the same as a standing pool, but would remain long enough to *drop all the silt and mud with which it would always come loaded*; and the Dry Docks would, in all probability, in a few months, become inaccessible and useless, by means of the accumulating mud, which would continue to rise on the sides to a certain height, perhaps nearly as high as a neap-tide; so that the part of the Harbour without the Lock, would become, in a great measure, useless. That this will be the case, I am convinced by experience, in a similar situation

uation where I was concerned, in the erection of a large sluice between Sandwich and Ramsgate, in Kent: Here the tide was stopped by a dam of grove-piles made across a cut about 100 feet wide, where the tide rose 18 feet: This dam was to keep the tide from the workmen during the building of the sluice: Here the mud accumulated in that part of the cut towards the sea, to the height of seven or eight feet, in about six months; and if the water be as *foul*, no doubt but it would do the same here: but it is not so foul, so the effect will not be so rapid, but will, in the end, be the case; for the water issuing through the sluices of the Lock-gates, will do no more than keep open a narrow channel in the middle, down to the point of the Pier, and there it would spread itself, and all its *feeble efforts to scour the Bar* would be lost; for the more powerful stream from the Citadel would take it in *flank*, and disperse it altogether: For I do account any artificial scour that can be procured here, and depending entirely on its *own strength, feeble*, in comparison of what they would be when acting in conjunction with the land floods, or even compared to the *land-floods alone*, with which the Bar is now scoured.

If the mud was not to accumulate, there would be another inconvenience that might sometimes cause a good deal of mischief; that is, when a ship comes into the Harbour under a brisk gale of wind, or in a storm, there would be a good deal of difficulty in stopping her way so effectually, as to prevent her running against the Lock-gates, or some of the works, and damaging herself or them, or both; yet any precaution will be unnecessary, for the accumulating mud would soon be an *effectual guard*, both to the Lock and other works.

THE above are the effects that I sincerely think *would*, nay, by the



the natural course of things, *must ensue* to the Harbour, if this plan was to be carried into execution.

I WILL now make a few observations upon the sketch which Mr Gordon has made upon the plan of the town of Leith, which he presented to your Lordship, with his comments upon it.

THIS plan of Leith, and the adjacent country, being so exceedingly convenient and easy to form plans for the improvement of the Harbour *upon*, is the reason your Lordship has been favoured with so many, and most likely will be favoured with many more.

THE situation which Mr Gordon has chose at the Timber-bush, is most certainly desirable, in respect of having a conveniency for building warehouses, and making roads to the adjacent country, and to Edinburgh. This did not escape my notice when I was taking the levels about the town; and had there been no *other objection* to it than what *Mr Gordon seems to know of*, I believe I should have fixed upon it as the most eligible situation for a Wet Dock, though at that time I did not conceive the purchase of the ground and buildings quite so easy as Mr Gordon makes it to be; and I am now informed by a principal proprietor, that the purchase for that *small inconsiderable Basin* sketched out upon the plan, would be about 5000l.

THE following objections and reasons, may, and probably will, also be urged against it.

THAT the carrying out the embankment into the sea, (which the sand and till dug out, would most certainly do to a great extent), would alter the *set and course* of the tide, and injure the channel; as I am informed, a projection recently made, of only about 20  
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or 30 feet, has caused sand-hills to accumulate near the end of the Pier.

THAT the embankment would cause a necessity of filling up the timber Pier, which now takes off the swell and fury of the sea in stormy weather, when the wind blows from the north and north-west, and prevents it going up the Harbour to incommode the shipping.

WHAT the force of the *first* of these arguments may be, I do not pretend to say; the Harbour-master, and shipmasters, who are so well acquainted with the place, must be the best judges of this matter. As to the *other* objection about the timber Pier, I think it ought not to have any great weight, if taking off the swell of the sea be all its use; for the *water's own gravity* will *soon quiet its fury*, when the wind can follow it no further.

THERE is another real inconvenience that a Dock made in this situation would be liable to; that is, the danger and difficulty there would be in conducting a ship into the canal of communication through the *Lock and Draw-Bridge*, when there is any wind. It is curious to observe, that Mr Gordon did not know this, when one of the principal objections he makes to the Basin at the Mille, was 'the dilatory operation of passing a Lock and Draw-Bridge,' when he must have *both*, and those placed in the most *critical situation* that can be imagined, and liable to be broke down or tore in pieces every day, when there is a quick flowing tide or any wind; or the ships must *pass by*, and *turn again* at a more convenient season.

To these objections and inconveniences, I must add one other, which, in my mind, *far outweighs* them altogether; and that is, the *extreme difficulty in the execution*: I will not say it is impracticable, but



but it borders as near upon it as any thing I can conceive: This Dock is proposed to be close upon the verge of the sea, where, I am informed, (from pretty good authority), there is 12 feet depth of sea-sand: This circumstance, if it weighs at all with Mr Gordon, seems to be in *favour*, from his observations upon it, which he gives in these words: 'The soil consists, I am informed, of sand, to a *considerable depth*, bedded with fine till; the digging, therefore, should not be more expensive in proportion, than the proposed Bafon at Leith Mills.' By this, I do suppose Mr Gordon has not had *much* experience in this kind of work; for this sand will most probably be of a quick kind: I have seen a great deal of digging in quicksand, and many foundations of Locks, Bridges, and other buildings laid; but I never saw a foundation of such an extent as this must be, in so *critical a situation*: The only way to effect it, with certainty, must be by inclosing the part with *grape-sheet piling*, made water-tight.

I SUPPOSE Mr Gordon did not think of these things, when he concluded his estimate to be 9000 l.

THE plan proposed by Mr Sheriff is upon the same ground, only it will take greater hold of the sea, which will increase the difficulty of fixing and driving the grove-piles.

I COME now to consider, and make a few remarks upon the Plan drawn out by Mr Ker.

THIS is the most grand design of any that has been exhibited: There is something so extravagantly expensive about it, that I could not at first believe there could be any serious intention, or even the most distant idea, that such a Plan would be offered to your Lordship and Council, for your consideration; but since *it is so*, and now  
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seems to be rather a favourite Plan, and espoused by a great number of gentlemen about Leith, and some in Edinburgh, I will shortly give you my opinion of the effects that may be expected in the execution of it.

THIS plan is proposed to extend from the present Harbour at Broad-wynd, eastward, almost parallel to the shore, to the distance of 1400 feet; the mean breadth about 200 feet. Upon this ground there now stand a great number of houses, warehouses, and other buildings, among which is a Church, and the new Assembly House. These buildings Mr Ker values at about 12,000 l., some say 17,000 l., others more; (but this I have nothing to do with). The depth of the digging I know (from the levels and survey I have taken) to be from 21 or 22, to 24 feet, supposing it to be dug to low water mark; about *ten feet* in the bottom is supposed to be *till*, and all the rest *sea sand*.

IF this ground had been clear of buildings of all kinds, the enormous expence that must attend making a Basin, or Wet Dock, in such ground, would have *deterred me from offering any such plan*. But as there is now an idea of *sewing* out the ground all round it, in the manner that has been done at the South Bridge, and almost at as great a price, and if it can be *sewed* out at *forty* or *fifty* pounds *per* lineal foot, on each side, which seems to be the prevailing opinion, this puts all consideration about the expence entirely and altogether out of the question. The only question to be *asked*, is, Whether it be *practicable*? This question I shall not make much difficulty to answer in the *affirmative*; yet it will, in all probability, be attended with more serious impediments and unforeseen accidents, than most gentlemen may imagine.



It being situate at some considerable distance *further* from the sea, than that proposed at the Timber-bush, I do not suppose it would be attended with quite so much difficulty; but understand the water will be troublesome, as I am told the wells in that quarter rise and fall (a little) with the tide, and are brackish, consequently, it must be *running sand*; therefore, it is most certain, that the foundation of the quay-walls cannot be dug to the depth necessary, except the space to be laid open, be first inclosed with *sheet-groved piling*, made water-tight; and this will be no easy matter to do: The quay-walls will require to be made very thick, and as well built, and as tight, in every respect, as *lock-walls*; with a great number of counterforts and land-ties, as the pressure from without will be very heavy, till the water be let in, which may be some years after the commencement of the building of the quay-walls; and after it is once filled, I do not think it would be adviseable to let the *whole* of it out again.

WHAT the expence of grove-piling, and digging out the foundation, and erecting the quay-walls, may be in such ground as this, I cannot even guess; therefore, would not wish to hazard an opinion in a matter so very uncertain, till I be better informed what the real nature of the ground is; the best way to come to a certainty would be to open a certain portion of it, which may easily be done in the open ground.

As to the prodigious quantity of sand and till to be dug out of the Basin, or Dock, which will be more than *two hundred thousand cubic yards*, there can be no place found to deposite it in, but the *sea*, (except a small quantity that may be carried away in ballast); and this would bring the objection of altering the course of the tide (before mentioned) with double force, as the quantity would be double.

I WILL now beg leave to observe, that this plan is laid out without much regard to œconomy; for there can be no necessity to carry the Dock to its full width, through the ground that is covered with houses and other buildings, which is the case from the Harbour to Quality-Street: this I mentioned to Mr Kerr, and that a canal of communication of about 60 feet wide, just to let the ships pass each other, would be sufficient: by doing it in this way, about half the houses, and other buildings, might be saved.

As nothing but the expectation of *sewing* out the ground to such advantage, can excuse the attempt to make a Dock upon this ground at such enormous expence, I would suggest to your Lordship, whether there may not be a like advantage made, by *sewing* out building ground upon the sides of the other proposed Docks: There would be plenty of room for this purpose, either at North Leith, or the Bafon above the mills: this latter place is a pleasant situation, and much nearer to Edinburgh, which, I should think, would make it more desirable.

I HAVE only one thing more to trouble your Lordship with, and that is, a remark or two upon the two very long anonymous letters, (which your Lordship last put into my hand) addressed to Sir James Hunter Blair, Baronet, from a *Wellwisher to Useful Improvements*, at Gilmerton, dated the 21st and 30th of December last.

THIS *Wellwisher* gives some useful hints, and in their operation would be innocent; but the improvement he proposes, is upon too small a scale for the City of Edinburgh to adopt at *this time*, when the *trade of Leith* is *increasing with such rapidity*.

ALL that this gentleman proposes to do, is, to take away the Bridge, and substitute either a Ferry, or Draw Bridge, in its stead;

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to widen and deepen the bed of the river above the Bridge; and erect a *pier* or *partition-wall*, up the middle of it, from the Bridge upwards; the ships to occupy the south side, and the floods to be confined to the north side; and the Quay to be extended as high as the *pier* or *partition-wall* reaches.

THE ships would lie secure here; and, a number of years back, this might have been thought a sufficient extension.

INDEED, this gentleman talks of removing Leith mills *further up*, and carrying his improvements up by Bonnington mills, to Canonmills; but the *level* will not admit him to go higher than *Leith mills*, with this kind of improvement, without a Lock or Locks. This circumstance he seems not to know, as he doth not mention any such thing: Though, at his first setting out, he says he '*understands the subject he is writing upon*'; yet in this he must be mistaken.

THE first part of this scheme might be made a good and useful appendage to the Basin above the mills, if there ever should be a necessity of making a greater length of Quay, or more *births and delivering places* than that Basin provides for; which is not very likely to be soon; for if that Basin be made in the form represented by Fig. 1. the Quay would be 3300 feet long. The way to make this appendage useful, if that should ever be the case, would be to continue the proposed Pier or partition-wall, from the north wing of the tail of the Lock, down the middle of the river, (as he proposes) to near the Bridge, then to take it in an easy curve, to the south abutment of the Bridge, and to make it wide enough for the horses to track, or haul up the ships upon; which would be easy to do, by making two parallel rough walls, and filling up the space between with the gravel or till dug up in making the river deeper:

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The present Bridge to remain as it is, for the floods to pass through, and a passage cut across the road and buildings at the south end of the Bridge, for the ships to pass through into this canal, which will be effectually guarded from the floods, and all possible injury; and the ships would always pass from the Bridge to the Lock in *still water*, let the floods be ever so great or rapid.

AND the Draw-Bridge to be placed over the passage, at the south end of the present Bridge, instead of having it at the New Quay, (as I proposed in my Plan and Report of the 7th November last): indeed, this is a much more preferable place for it; for, by placing it here, the present Harbour will have no more obstruction than it has now.

I SHOULD have proposed to have placed the Draw Bridge here at first; but it could not be made without pulling down some houses which I then thought almost sacred, and not to be taken down, except the measure could not be avoided: But since others make so little ceremony in proposing to take down near an *hundred*, I will here propose to take down *two or three*; and beg leave to alter the situation of the Draw-Bridge from what I then proposed.

If this Canal be made about 60 feet wide, in the narrowest place, (if the river will not allow it to be wider), there would be plenty of room for the ships to *lie at the Quay and deliver*, and for others to pass through up to the Basin.

THUS, my Lord, I have gone through with my observations and remarks upon the objections to the plans I proposed, and upon the other plans and papers which your Lordship and Council did me the honour to submit to me, in as short a manner as the nature and importance of the subject would admit, which has unavoidably drawn out this letter to a much greater length than I at first



first expected. My desire has been to make the matter as plain as I could; which, though I have not the art of doing in so few words as I could wish, yet I hope your Lordship will be so good as excuse.

I am, with the greatest respect,

My LORD,

Your Lordship's most obedient,

and very humble Servant,

EDINBURGH,

JAN. 8. 1787.

ROBT. WHITWORTH.

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and I could wish that I hope your letter will be its proof.

Superficially, the film is a

1941



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THE UNIVERSITY OF CHICAGO

AND BY WILLIAM O. R. E.



